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Report 4:

FUEL REDUCTION OPTIONS FOR LANDOWNERS AT THE WILDLAND-URBAN INTERFACE

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Introduction

The wildland-urban interface can be defined as the area where fuels for wildfire change from being natural to man made or “urban” (Butler 1974). The tranquility and natural setting of wildland areas are characteristics that are appealing to many who desire to leave the congestion and fast pace of the city. These appeals, coupled with the need to grow due to increases in population, have resulted in an urban sprawl that has placed many homes at the interface. A primary threat to these homes is damage or destruction from wildland fire.

Fire is a natural occurrence in many plant communities across the South. In fact, some plant species depend on fire to complete or maintain their life cycles. Ecosystems that burn regularly rarely encounter catastrophic fires, because the fuels on the forest floor, or surface fuels, do not accumulate to hazardous levels. Periodic fires, caused by either lightning or prescribed burns, consume much of the fuel on the forest floor. As people and homes encroached on rural areas, regular fires were suppressed to reduce risk to structures. This suppression allowed vegetative growth to go unchecked and to amass fuel loads capable of supporting intense fires.

Figure 1. Wiregrass, *Aristida beyrichiana*, is a fire dependant species. This photo was taken just two days after a prescribed fire in Waldo, FL. Notice the new shoots emerging. (Photo by D. Doran)

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Fuels, in a wildland situation, are defined as plant materials that can ignite and support a fire (Bond and van Wilgen 1996**.** They can originate from an abundance of sources but are primarily living and dead material from grasses, vines, shrubs, and trees. In many southern forests, substantial amounts of fuel accumulate every five to six years (Wade and Lunsford 1989). The reduction of fuels around structures will greatly reduce the risk of damage caused by wildfire (Cohen 2000).

Vegetative fuel reduction is a principal component of most wildfire hazard mitigation plans (Florida Division of Forestry 2000). However, conducting fuel reduction practices can be complex for individual landowners, especially for those owning parcels greater than one acre in size. Many interface properties are either too small or are in unsuitable locations to perform the fuel management techniques that are typically used on larger landholdings. The primary goal of this report is to investigate fuel management techniques that are suited for small landowners living in the wildland-urban interface. Prescribed fire, herbicide treatments, mechanical treatments, and the utilization of livestock for fuel reduction will each be reviewed for their effectiveness and associated costs.

Prescribed Fire

Prescribed fire is the controlled application of fire over a predetermined area to achieve a specific set of objectives (Florida Division of Forestry 2000). A prescription is usually written for each fire that includes a set of environmental conditions that are required before ignition can occur. It is a tool that has been used for fuel reduction since the early 1900's (Wade and Lunsford 1989).

Other beneficial uses for fire include: increased accessability to stands, nutrient cycling, wildlife habitat improvement, ecosystem maintenance, increased palatability of vegetation for grazing animals, and site preparation for reforestation. In the South, about eight million acres are burned annually using prescribed fire (Wade and Lunsford 1989). Due to increased populations at the interface and other social factors, that statistic is expected to decrease in the future.

In interface situations, the most common objective of prescribed fires is the reduction of hazardous fuels. Given that objective, prescriptions vary based on season of burning, existing fuel loads, and current weather conditions. On sites that have not had fire within the previous 8-10 years, initial burns should be conducted during the cool season (Campbell and Long 1998, Sackett 1975).

A number of firing techniques exist for conducting prescribed burns. In sites with heavy fuel accumulations, backing fires are the most common. A backing fire is set on the downwind side of the desired burn unit; because the fire moves against the wind, flame heights remain low. This is the slowest firing method, moving 60-200 feet per hour, but it is the safest in areas with heavy fuels (Wade and Lunsford 1998).

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Figure 2. A prescribed burn near Waldo, FL designed to reduce hazardous fuels. (Photo by A. Behm)

Head fire and strip-heading fires are set on the upwind side of a burn area, which allows the wind to “push” the fire in the direction of the fuel. They are more intense and faster moving than backing fires, and they usually consume a greater percentage of available fuel (Wade and Lunsford 1998). For fuel reduction burns, head and strip-head fires should be used carefully and when fuel loads are low. Due to differences in fuel moistures, fuel loads, dominant vegetation, and other variables, the results of a prescribed burn may not be uniform across a burn unit. Burned areas should be evaluated to determine the effectiveness of the treatment in accomplishing the stated objectives of the fire (Wade and Lunsford 1998).

Prescribed fires must be repeated in order to maintain safe fuel loads. Sackett (1975) determined that a three-year burn interval is optimum for minimizing wildfire potential and damage. Also suggested was the use of back fires when initiating a burn program, especially in areas that contain heavy rough. McNabb (2001) suggests that cool season, backing fires can be conducted every two to five years. A twelve-year study in Florida determined that one year after a burn, the total amount of accumulated litter was 4,339 pounds per acre (ovendry). After the second year that number increased to 5,930 pounds per acre (ovendry). At the end of the fourth and twelfth years, accumulated fuels were 8,092 and 13,847 pounds per acre (ovendry), respectively (Sackett 1975). After 8 years, the fuel accumulation began to level off. The same study determined that the understory increased in height as well as weight. Gallberry measured 15 inches in height in first year roughs but grew to 42 inches by the twelfth year. Palmetto had a similar response, growing from 26 inches to 45 inches over the same time period. Height growth directly affects fire behavior, increasing the amount of available fuel and making it more vertical in form (Sackett 1975). In another study, a February prescribed fire reduced gallberry coverage by five percent and litter coverage from 17.7% to 8.7% (Moore et al. 1982).

Figure 3. A prescribed backing fire used for fuel reduction at Austin Cary Memorial Forest near Gainesville, FL. (Photo by D. Doran)

In 1998, the overall cost for prescribed burning in the South increased 13% over the previous two years (from $14.65 to $16.58 per acre). The cost of three different burning treatments ranged from $10.00 to $31.14 per acre (Dubois et al. 1999). The range of costs reflects differences in objectives, fuel loads, burn unit size, and other variables. Private companies or consultants plan and execute prescribed burns for a fee. Private landowners can also get assistance from state agencies to carry out prescribed burns. Often, the state assistance is free if the objective of the burn is wildfire hazard reduction. For example, in areas where private vendors cannot provide the service, the Florida Division of Forestry will assist landowners burning up to 250 acres per year. They will contract burn for $10.00 per acre for the first 50 acres or less and $6.00 per acre for additional acreage. In addition, they will construct fire lines at a rate of $50 to $80 per hour (Florida Division of Forestry 2000).

There are inherent risks associated with prescribed burning. The obvious risk is that a fire will escape its intended burn area and cause human casualties and property loss. Smoke management also generates a large amount of concern. Smoke can greatly reduce visibility on roads and near airports (Winter et al. 2002). There are also health issues involved with the dispersion of smoke in populated areas.

Prescribed fire is an effective tool in the management or reduction of hazardous fuels. Objectives for a fire must be set ahead of time, and proper methods should be used to achieve those objectives and ensure safety. In the South burning should be repeated every two to five years to keep fuel loads at manageable levels. Prescribed fire is often the most efficient method of fuel mitigation when conducted in a professional manner. However, not every situation allows for the use of fire. When potential risks outweigh the benefits of a burn, alternative methods of fuel reduction should be investigated.

Herbicide Treatments

The use of herbicide to reduce hazardous fuels is one alternative available to private landowners living at the wildland-urban interface. Herbicides are chemicals that have been developed to control or kill specific groups of plant species. Plants such as gallberry and saw palmetto, that are considered to be fire hazards in the South and rapidly resprout after prescribed burns, can be controlled or eliminated by using herbicides.

Three primary types of herbicide exist: foliar active, soil active, and those that are both foliar and soil active. Herbicides that are foliar active enter the plant through the leaves and occasionally the stem. Soil active herbicides are taken up through the roots of the plant. The herbicides are distributed through the plant by moving with food through the phloem, or with water through the xylem (McNabb 1996). Each herbicide contains an active ingredient that dictates the species that the herbicide will effectively control. Common forest herbicides and their active ingredients are listed in Appendix 1.

Three important components of an herbicide prescription are: the proper product to use, the rate at which it is applied, and the season or time of year for the treatment. Common prescriptions can be found in Appendix 2. These three considerations depend solely on the objective of the treatment or the target species.

A number of methods are available for applying herbicides. Each method is directly related to the size and species composition of the area where the application is to take place. On large parcels of land, tractors rigged with spray equipment and aerial applications (helicopter and airplane) are common. All-terrain vehicles and hand sprayers are used on smaller tracts.

Figure 4. A farm tractor with spray rig applying herbicide treatment at Austin Cary Forest near Gainesville, FL.

Herbicides are especially effective when used in accordance with a sound prescription. A single treatment provides long-term reduction of hazardous fuels and changes in species composition, but the effect on fuels is not immediate. In a study conducted in Florida, Brose and Wade (2002) reported that shrub fuel loads changed little during the first year after an herbicide application. After one year, there were 8.54 tons per acre of one-hour fuels and 2.06 tons per acre of ten-hour fuels. However, the amount of live woody material was reduced from 2.96 to 0.18 tons per acre during the first year. Dead rough remained standing during the first year, contributing to this trend. In the beginning of the second year, the rough began to decompose and the fuel loads were greatly reduced; the forest floor also became more open. One-hour fuel loads continued to decline over time with 7.87 tons per acre recorded after three years and 5.32 tons per acre after six years (Brose and Wade 2002). These results suggest that a properly applied herbicide treatment could last as many as eight to ten years before reapplication is needed.

The cost of herbicide treatments is dependent on the management objectives and the specific nature of the application. In the period between 1996 and 1998, average treatment costs increased from $67.65 per acre to $72.32 per acre (Dubois et al. 1999). However, these figures were reported for forestry applications. Smaller landowners may expect to pay more per acre due to the small size of the area treated and associated costs of moving equipment. Treatments applied for a recent study on five acres outside of Gainesville, FL cost $86.50 per acre. These treatments were conducted in conjunction with a larger application that helped offset the price. The highest bid for the same application approached $112 per acre. One reason for the high cost of herbicide treatments is the cost of the herbicide itself. Products range in cost from $55 per gallon to near $450 per gallon. Private individuals should be aware that a special permit is required to purchase some forest herbicides. All herbicide labels should be read and studied before their use. It is illegal to use herbicides in a manner that is not consistent with the label.

A few risks are associated with the use of herbicides. The primary problem is the social acceptance of the method. Many people are unaware that most herbicides target specific species, and they incorrectly assume that herbicides kill everything that they touch, both plants and animals. Most of the risk incurred when dealing with herbicide treatments is to the applicator and such problems are avoided by taking the necessary precautions

Herbicides are a useful fuel mitigation tool for landowners at the interface. Private consultants can provide assistance to landowners, from start to finish, creating the prescription and seeing it through to completion. An important task in the development of an herbicide prescription is the determination of the appropriate application method. To meet the specified management objectives, the treatment should be applied in accordance with the prescription and special care should be taken to follow label instructions.

Mechanical Treatments

Mechanical treatments are becoming one of the most popular methods for fuel reduction. There is less risk involved in conducting a mechanical treatment than prescribed fire. However, social acceptance of mechanical treatments (especially thinning) is threatened because much of the public perceive it as simply a way to harvest timber (Winter et al. 2002). Mechanical treatment utilizes a piece of equipment to reduce fuels. Examples of commonly used equipment include an axe, a tractor pulling a roller chopper, or mowers. The selective removal individual trees to reduce overall tree density is called thinning and can be considered a mechanical treatment of hazardous fuels.

Most of the equipment used in mechanical fuel reduction is expensive; therefore, purchasing the equipment is not a viable option for most landowners. Large tractors are needed to pull and/or push many of the currently available implements. The two primary types of mowers are flail and rotary. A flail mower, in most cases, fits on the front of a tractor. A barrel fitted with small knives or chains rotate in the direction that the tractor is moving, cutting vegetation to ground level. Rotary mowers are pulled behind the tractor and have rotating blades that cut the vegetation. Roller choppers are also used to reduce fuels. A roller chopper is large and cylindrical with blades welded across the flat surface. The weight of the implement crushes vegetation and debris greatly reducing the standing fuel load. As noted before, using an axe or machete to reduce fuels is also considered a mechanical treatment, but both tools are associated with a high risk of injury for landowners.

Figure 5. A tractor fitted with a front mount rotary mower used to conduct mechanical fuel reduction treatments. (Photo by A. Long)

Brose and Wade (2001) determined that thinning is a viable way to reduce fuels. In a study conducted in Florida, they observed a reduction in one-hour fuel loads from 33.47 Mg/ha to 9.79 Mg/ha following a thinning treatment. Five years after the treatment, fuel loading of one-hour fuels remained lower than pre-treatment levels (19.17 Mg/ha). Similar results were achieved with respect to ten-hour fuels, however, live woody material was found to be more resilient. Live woody material was reduced from 12.9 Mg/ha pre-treatment to 4.08 Mg/ha post-treatment. Five years later the site had regained almost 75% of its original live woody material (9.07 Mg/ha). These results suggest that a thinning treatment would remain effective for a maximum of five years after which sprouting vegetation returns fuel loads to pre-treatment levels. Though mowing methods of fuel reduction are gaining popularity, research is needed to assist landowners in assessing the longevity of these treatments.

The costs of mechanical treatments can be prohibitive. The equipment itself can cost tens of thousands of dollars. Private consultants and contractors offer the most affordable means to small landowners. The average cost of site treatments went up between 1996 and 1998 from $108.05 to $122.14 per acre. These treatments were conducted for forestry, and prices could vary when applied to small private landowners (Dubois et al. 1999). Private contractors using Positrac machines often charge $100 per lot. These machines operate at a rate of about one acre per hour. The Florida Division of Forestry (2002) charges between $60 and $100 per hour using similar machines. The cost of these treatments can be very high, but they are effective methods to reduce hazardous fuels for small landowners.

Livestock

Another fuel management alternative for landowners utilizes livestock to reduce ground-level fuels. This method involves fencing off the areas that need treatment and allowing livestock to forage. Davidson (2002) reported that homeowners living adjacent to sheep grazing treatment sites in Nevada were overwhelmingly supportive of that method and preferred it to other mitigation techniques.

Davidson placed 350 sheep into an area approximately 2.5 miles long and 150-200 feet wide. The sheep were contained using an electric fence. After the first growing season, standing fuels were reduced in amounts ranging from 765 pounds per acre to 2,622 pounds per acre. The reduction is attributed to the sheep consuming and trampling much of the fuel. Two growing seasons after the treatment, the standing fuel load was reduced to half of that found on an adjacent untreated area (Davidson 2002).

In California, goats have been used for similar treatments. Angora, Spanish, Boer, Pygmy and Alpine goats are combined in a herd due to their individual preferences regarding native vegetation or fuels (Morales and Oyarzun 2002). In the grazing system in California, landowners pay farms to graze their goats on private lands. The goats are tended by a shepherd, who is responsible for moving the goats along at a pace necessary to achieve the desired objectives. Goats can consume plants down to bare ground if needed (Morales and Oyarzun 2002). Another advantage that livestock have over other methods is that slope is less of a limiting factor, although this is not a problem in much of the Southeast. Cattle grazing will also reduce hazardous fuels. For hundreds of years, ranchers have grazed cattle on the natural vegetation in southern ecosystems. Grazing can help offset the costs associated with maintaining a herd by reducing the amount of feed the ranchers need to purchase. Although there is little scientific evidence to support the effectiveness of cattle grazing, it is thought to be a useful way to reduce hazardous fuels (Tyree and Kunkle 1995).

There are many costs associated with grazing for fuel reduction. Morales and Oyarzun (2002) discuss the notion of “leasing” a herd of goats or sheep in detail. Although a total cost is not mentioned, they report that the cost will vary depending on the location and the amount of vegetation. The individual who owns the herd incurs all costs associated with tending the animals. No information exists in literature on similar lease agreement for cattle. Although land is often leased for cattle grazing, fuel reduction is seldom the primary objective.

When a landowner decides to purchase and tend to a herd of animals, numerous additional costs will be incurred. Water is a necessity and can be a primary expense. Cattle consume about 12-15 gallons of water per day. If a water source is not available on-site, a well must be built (Tyree and Kunkle 1995). The construction of a containment fence can be another substantial expense, if no fencing is present. Health maintenance of the herd includes additional costs associated with vaccinations, parasite control, supplemental feeding, and working facilities. Finally, the price of the cattle themselves can be high. Cattle can be purchased at auctions where calves can cost from $200 to $500 each. Each individual in a cattle herd requires a minimum ¾ to 2 acres of forage (Tyree and Kunkle 1995). Some of the purchase cost is recovered if/when the animals are eventually sold.

Grazing animals are effective tools for managing undesirable vegetation, but the disadvantages associated with their use should also be considered. Erosion and compaction can be negative impacts caused by grazing animals (Morales and Oyarzun 2002). The initial expense of starting a herd of grazing animals can be high. Maintenance of the herd requires a trained individual, and contracting such a person can lead to additional costs for the landowner. Fewer risks are associated with leasing the animals from a reputable farm than growing and maintaining a herd.

Conclusion

The growing number of residents who live in the wildland-urban inteface should be aware of the risks to which they are exposed. These interface areas pose specific problems with respect to wildfire and hazardous fuel management. Prescribed burning, the most efficient of the treatments, is becoming a tool of the past in interface areas, due to the risk that it poses to the encroaching populations. In light of this fact, additional methods of fuel reduction need to be developed and implemented. Several alternative methods exist that can be safely and effectively used. Herbicides treatment can be an effective method of reducing hazardous fuels. Although the effect is not immediate, herbicide treatments provide lasting protection from wildfires. Mechanical treatments, though expensive, provide immediate reduction of standing fuel loads. These treatments often need to be reapplied more often than herbicides. Additional research is needed to determine exactly how effective the treatments are and the length of their usefulness. Grazing livestock on areas with hazardous fuel loads is also a viable option. The general public often views this method as the best option. Successful applications of goat and sheep grazing have been documented in the west. Farms lease their animals to private landholders for the purpose grazing to reduce fuel. This method can be expensive if initiated by an individual landowner.

As property owners realize the need for fuel management, they should be made aware of efficient and lasting methods that will help accomplish their goals. Each situation has unique characteristics, and a plan should be developed individually. This plan should take into account the owner's objectives, the fuel loads, and the surroundings (roads, airports), and match them with the fuel management technique that best suits their needs. The reduction of hazardous fuels is a necessary hazard mitigation activity for landowners at the interface, and the alternative methods described in this paper offer an effective means for landowners to reduce the risk that wildfires pose to their properties.

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Appendix 1

Commonly used forestry herbicides and their active ingredients.

Product	**Active Ingredient**
Accord	Glyphosate
Arsenal	Imazapyr
Atrazine 4L	Atrazine
Chopper	Imazapyr
Escort	Metsulfuron methyl
Garlon 3A	Triclopyr
Garlon 4	Triclopyr
Oust	Sulfometuron
Pronone 10G	Hexazinone
Velpar L	Hexazinone

(McNabb 1996)

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Appendix 2

General Herbicide Prescriptions.

Herbicide Prescription for Herbaceous Weeds (Grasses and Forbs)

Herbicide	Formulation	Timing
Accord + Arsenal	4 qt + 8 oz/A	Summer
Garlon + Arsenal	2 qt + 8 oz/A	Summer
Oust	4 oz/A in 15 gals water	Spring
Oust + Velpar L	2 oz + 1-2 pts/A 15 gals water	Spring
Oust + Atrazine	2-4 oz + 2-4 qts/A	Spring
Oust + Accord	2 oz + 1 pt/A	April-May
Arsenal + Oust	4-6 oz + 2 oz/A	Spring
Arsenal	6-10 oz/A	Spring/Summer
Escort + Arsenal	2 oz + 8 oz/A	Summer
Velpar L + Oust	3 pts + 2-3 oz/A	Spring

(Long 1998)

Herbicide Prescription for Evergreen Shrubs (Gallberry, Waxmyrtle)

Garlon 4 + Arsenal	1-2 qt + 8-12 oz/A	Fall
Accord + Arsenal	2 qt + 8 oz/A	Fall
Garlon 4 + Arsenal	2 qts + 12-16 oz/A	Fall
Accord + Arsenal	5 qts + 8 oz/A	Fall

(Long 1998)

Herbicide Prescription for Saw Palmetto

Garlon + Accord	1-1.5 qts + 1.5 qts/A
Garlon + Chopper	1 pt + 40-48 oz/A

(Long 1998)

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